

What are the Effects of Hog CAFOs on Local Black Communities in North Carolina?

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Abstract

A large number of industrial hog farms have popped up throughout North Carolina without developers thinking about the health effects they may have on the communities nearby, especially communities of color. The research presented today looks into the health effects of Hog CAFOs or Concentrated Animal Feeding Operations. It theorizes that life expectancy will go down for local communities near hog CAFOs and that black communities will be more affected than white communities. This is because CAFOs are often placed on cheap land and white communities often have the means to move away from the industrial farms. To test the hypothesis, life expectancy of both the Black and White populations as the dependent variables, and hospital bed capacity, poverty rates, and uninsured rates as control variables. The variables are tested with hog numbers per ten thousand people and then again with hog farms per ten thousand people as the independent variables. The results found that there is a positive effect of being near hog farms, which was not consistent with my expectations. However, the results were not substantially or statistically significant. These puzzling results suggest that more work should be done to understand these dynamics.

Introduction

During a trial where over 500 defendants sued Smithfield Foods, a fourteen-year-old described how living near a hog CAFO has negatively impacted her life, from not being able to play outside on a sunny day to hearing pigs squeal out her bedroom window. Living near an Industrial Hog Farm has left her far from having a normal childhood¹⁸ This is far from unusual for the many residents living near Hog CAFOs. For many, this is everyday life. A resident of Kenansville told reporters about how he always wears a mask outside, while another talks about how they often get itchy eyes when going outside⁹. This is the day-to-day life for communities near hog CAFOs, many of which are filled with Black residents. On top of that, school students who attend school close to swine operations are 24% more likely to show asthma-like symptoms⁷, showing real-life health effects on local communities.

This leads to the research question of what is the health effect of hog CAFOS on local Black Communities in North Carolina? To first understand the effects of hog CAFO on Black communities, you have to understand the industrial hog system within North Carolina. Prior to the nineties, most farms in North Carolina were small family-run farms and very few were industrial-sized. Now, most hog farms that are running in North Carolina are large industrial CAFOs. CAFO stands for concentrated animal feeding operations and these operations often have thousands of pigs within one livestock building that are seldomly let outside. Most CAFOs are contracted in North Carolina because of the relaxed laws that many states don't have when it comes to industrial farming practices and

the relaxed enforcement of regulations. This means that hog CAFOs have completely been allowed to create waste lagoons in order to hold hog excrement that on certain occasions, will be sprayed onto nearby fields. This may seem minuscule, but with counties such as Duplin having almost 2 million hogs¹⁷ yet having a population around 60,000¹⁶, it is anything but. I argue that the waste from hogs and the proximity of these farms to densely populated areas have caused negative health effects on communities nearby, especially communities of color.

It is very important to include race in the analysis of the effects of CAFOs because the areas where they are concentrated also have a high concentration of Black people. Exploring environmental racism and justice through my research is also extremely important to me as the environmental justice movement originally started in North Carolina. Furthermore, it has been proven time and time again that the first people affected by the climate crisis will be people of color and it is necessary for political science to pay close attention to the effects of environmental racism on diverse communities a

To evaluate the arguments presented, I took a statistical approach, using data from the USDA's Census of Agriculture and data on life expectancy from the North Carolina Department of Health and Human Services. The results ended up showing that hogs and hog farms have a positive effect on the life expectancy of both Black and White populations, contrary to my expectancy, these results ended up showing a small effect on life expectancy and ended up not being statistically significant. The dataset also had certain limitations put on it, as only a small amount of data is accessible that was broken down by race on the county level.

In this paper, I will first review the literature on environmental justice and hog CAFOs. After, I will explain my theory where I go into greater detail about how these farms harm communities, especially black communities. Then, I will show how I evaluated my arguments through my research design and describe the data I will use in order to obtain my results. After, I will introduce the results and explain my findings. To conclude my paper I will be discussing the implications of my research and suggest avenues for future research.

Literature Review

There is a substantial amount of literature published on the effects of Hog CAFOs on different communities throughout the United States. A large portion of that literature is based on North Carolina since it has a higher population density compared to other states with high CAFO density, such as Kansas. Much of this work has been written in the past couple of decades. Wing and Wolf¹⁵ were the first to look into the conditions of local communities in North Carolina. They conducted a survey to assess the physical and mental health effects of locals living near hog operations compared to cattle operations and no operations at all. This research caused the ripple effects of more research being done on this topic, as it found substantial evidence of hog operations being adverse to the mental and physical health of local communities. It also points out the effects on Black communities, as they were the main communities surveyed. This fact has been further examined through academic work, such as the study by Wing and Johnston¹⁴ where they look at the demographics within three miles of 2,055 hog CAFOs and found that people of color are 1.54 times more likely to live within close proximity of pig operations and live near 100,000 more pounds of pig waste than their white counterparts. These facts are then brought into a more humanizing narrative through a case study on locals living in Kenansville, North Carolina, and how many have to wear masks to go out into their yard and never open their windows. With most of these residents being a part of the black community⁹. This obviously has negative effects on the communities living within this area as stated above. Literature such as Kravchenko et al.⁶ goes deeper into what Wing and Wolf originally studied and found that mortality rates in communities close to high hog concentration to be 934 per 100,000 compared to the United States average of 750 per 100,000. Additionally, the study found that the mortality rate for health issues associated with hog CAFOs, such as asthma, were higher in those zip codes compared to the United States and North Carolina average.

Although all of these articles are important pieces of literature on the effects of hog CAFOs on local communities, there are a few holes in these studies. Most of the studies conduct their analyses by zip code. This could be a problem especially if a person lived in a zip code without a hog CAFO, but lived less than a mile away from one on the edge of another zip code. This can cause undercounts of the actual number of people affected by these operations. Son et al¹² further explores this in their article and explain how the metric they use includes areas within the general area around the CAFO and not just the zip codes within it. Their usage of this Buffer method showed that there is a substantially higher level of Racial Residential Isolation for African Americans than known before using the zip code-heavy Count method. Racial Residential Isolation is a scale used to measure the level of segregation by a minority group within a specific area. The one downfall of this article is that it uses all types of CAFOs and not just hogs, although hogs do account for 88% of all CAFOs within North Carolina.

Theory

As discussed in the section before, the switch to industrialized hog operations from smaller family farms within North Carolina has raised questions within the academic community. It is an especially important topic to look into because of the gray area that CAFOs fall into law-wise, such as the fact that they are exempted from reporting any air emissions to the Environmental Protection Agency². Because of this, the communities surrounding hog CAFOs are especially vulnerable to the health and environmental effects that waste from CAFOs produces.

One of the worst environmental problems caused by CAFOs is the fact that they produce over 4,145 waste lagoons of feces, urine, and blood created on CAFO land in the eastern part of the state, 136 of which are found near public water wells³. Waste lagoons were created as the quickest way to get feces and other waste out of the immensely packed pig lots, as they are not treated and often sprayed onto nearby fields. CAFOs with 800,000 pigs could produce over 1.6 million tons of waste a year, which is one and a half times more than the sanitary waste produced by the city of Philadelphia¹. Waste lagoons can get so large that they flood entire areas and seep into rivers during hurricanes. This happened during Hurricane Matthew in 2016, during which the flood water seeped into the Cape Fear, Neuse, and Black Rivers and submerged 10 CAFOs³. Situations like this can cause drinking water pollution. Future, the excrement that gets sprayed on CAFO fields often also gets sprayed on fields of local citizens. This can often cause respiratory issues for the people living in these areas.

There is ample evidence of the adverse health effects that CAFOs have on the local environment and communities that live nearby. This is an environmental and health injustice, but I argue that it is also a racial injustice as most of the people that live near these CAFOs are people of color. In a study done on the population near hog CAFOs, the authors found that there are 1.52 times more POC living within three miles of a CAFO than Non-Hispanic Whites. They also found that specifically, 1.54 times more Black people live within a 3-mile radius compared to Non-Hispanic Whites¹⁴. A large cause of this is the fact that much of the Black community within these areas live on “less desirable” land that is often cheap and many large hog operators find it enticing to move to the area on top of the relaxed farming laws the state has. If there are any white people in these areas, oftentimes they have enough money to sell their land and move while a lot of people of color are stuck in the current situation.

This leads me to my hypothesis which is that Hog CAFOs negatively affect the local communities of color, specifically Black communities, especially in terms of health outcomes. Many large pork producers moving into the state decide to choose the cheapest land available. Most of the land they move to are often owned by Black people or exist within Black communities. That lowers the land value and further lowers the wealth level of the surrounding area. Once members of these communities start to feel the health effects and want to sell their house, their land value is already extremely low, leaving them stuck with having to deal with the brunt of the effects such as respiratory issues, brain damage, and higher mortality rates.

Because hog CAFOs are rarely held accountable for their actions on the environment, they will often not have much of a care for the effects of their actions on local communities surrounding them. This causes awful health effects to the communities around them if they are living around a large amount of pig waste that releases ammonia and E.coli. With many of these communities being filled with people of color, this quickly turns into an Environmental Racism issue.

Research Design

In order to test my theory, I decided to take a statistical approach and specifically focus on North Carolina. My unit of analysis consists of counties within North Carolina in order to have a better understanding of regional differences. Counties were the smallest unit found to get the specific data needed although the analysis could have more detailed outcomes with smaller units. Although there are one hundred counties within the state of North Carolina, I was only able to include 69 counties in the analysis due to the data limitations on the independent and dependent variables of interest.

The dependent variable in my analysis is the health outcomes of the Black and White populations within the counties throughout North Carolina. In order to measure the health outcomes, I decided to use life expectancy broken down by race from the NC Department of Health and Human Services. Using the life expectancy of both the Black and White populations will allow me to compare the effects of hog farms on both populations. The average life expectancy for the Black population within North Carolina is 75.1, which is 2.5 years lower than the White average life expectancy, which is 77.7. The county with the highest Black life expectancy rate is 82.2 within Camden County and the lowest is Robeson County at 71.4 years. That alone is more than a ten-year gap when it

comes to life expectancy. The standard deviation of Black life expectancy is 1.889 years. The white population has slightly higher statistics with the highest life expectancy rate being Orange County with 83.1 and the lowest life expectancy also being Robeson County with 74.5 years. I found that the standard deviation for the white population is 2.051 years.

The independent variable in my analysis is the concentration of hog CAFOs within different counties within North Carolina. Using the USDA Census of Agriculture, I accessed data on the number of hog farms within North Carolina counties and also on the number of hogs within each county in 2017. Although this data is very useful, I did run into a few obstacles collecting it. First, the data from 20 counties were withheld by the USDA in order to protect individual farmers and therefore made it impossible to count those counties for the analysis. Another issue I ran into was that some counties had data for farm numbers from 2017 but only had Hog numbers from 2012, which was the previous Census of Agriculture year. When 2017 data was not available, I used the 2012 numbers, but this is a limitation of my analysis. I used the raw numbers of hogs and farms in each county to calculate the number in each county per 10,000 people. This will allow me to more directly compare counties. I found that the average number of Hogs per county was 28,402.46 per 10,000 people which seems pretty high, as that would suggest that in the everyday North Carolina county there are more hogs than people. The lowest amount of hogs within a county ended up being 3.05 per 10,000 people from Vance County and the highest amount came from Duplin County with a whopping 401,799.04 per 10,000 people. The variation of hog numbers within North Carolina is extremely large and the standard deviation reflects that at 78,612.73. Along with hog data, I also collected farm data per 10,000 people. The average county has 6.05 farms per 10,000 people which sounds significantly lower compared to the pig average. The highest rate is 55.01 farms per 10,000 people, which, like the number of hogs, comes from Duplin County. The lowest number is .18 from Guilford County. The standard deviation of farms was 9.99. I decided to use the number of hogs as an independent variable as it can dictate how much hog waste is produced in a single county and can correlate to having higher health effects within an area. I also used the amount of farms per 10,000 in a county as an alternative measure to understand the concentration of farms within an area that could be potentially releasing waste onto areas within the counties.

I understand that this data alone cannot be used to analyze the health effects of hog CAFOs on Black populations and decided to control for other factors, such as the percentage of the population without health insurance, the poverty rate, and the amount of hospital beds within an area per 10,000 people. I use these factors as controls because not having things, such as healthcare, can tremendously affect the number of years you live. If you cannot afford to see a doctor or if there are no hospitals within your county, this can have an obvious effect on life expectancy. Seven counties I collected data for did not have any hospitals at all. The county with the highest hospital bed count per 10,000 people was Orange County at 54.94. The standard deviation was 13.06 and the average was 19.00. The highest poverty rate by county was 31.5% in Robeson County and the lowest was 7.6% in Camden County, which are two widely different numbers with a 23.9 percentage difference. The standard deviation for poverty rate is 4.62 and the average is 15.8. The last factor I used was the percentage of the population within a specific county who is uninsured. The county with the highest uninsured rate consisted of Duplin County at 21.6% and the lowest was Wake County at 10.1%. The standard deviation for uninsured rates is 2.289 and the average is 14.42. I found both the uninsured rate and the poverty rate through the U.S Census Bureau. I found the number of hospital beds through the North Carolina Department of Health and Human Services.

Analysis

After collecting my data, I ran regressions to evaluate my claims. I expect the concentration of hogs and hog farms to lower life expectancies within the Black community in particular and generally overall. I estimated four regressions to see if this is the case.

In my first regression, Black life expectancy is the dependent variable, while the number of hogs per 10,000 people is the independent variable. I also include my control values which are the uninsured rate, the poverty rate, and hospital capacity per county. The results I found are presented in Table 1. The coefficient for the number of hogs finds that it positively impacts the life expectancy of the Black population within the dataset. The effect found, although positive, is extremely minimal as for every hog added per 10,000 people, the life expectancy of the Black population goes up by .000005. The effect is also not statistically significant as the p-value is .1, which is higher than the threshold for a p-value to be statistically significant. The results I found do not support my hypothesis and suggest that hogs have little effect on the outcome of interest. For the control variable of poverty, for every 1% increase in poverty, Black life expectancy declines by .22 years. The results found are pretty substantial and are statistically significant with the p-value being below .05. When looking at the uninsured rate, the results indicate that

it has a negative effect on Black life expectancy. A one percent increase in the uninsured rate decreases life expectancy by 0.05 years but the p-value being at .654 means the value is not statistically significant. The coefficient for the other control variable of hospital capacity showed a negative effect on Black life expectancy which was unexpected. The effect is not statistically significant.

The next regression I run is to see the effect the number of hogs has on the life expectancy of white residents within North Carolina. I hypothesize that the effects would be negative like with the Black life expectancy. The results I found are presented in Table 2. The regression shows that the number of hogs has a positive effect on white life expectancy as it does on black life expectancy, but the effect is extremely small with the effect only being .0000038 additional years per hog added. The p-value is also entirely too high for the effects to actually be statistically significant. This result is contrary to my expectations. The effects of being uninsured on white life expectancy are also positive. The coefficient suggests that a 1% increase in the uninsured rate increases white life expectancy by 0.03 years, which is surprising. But the effect is relatively small and not statistically significant. The control variable of the poverty rate ends up being negative with an effect of .24, which is pretty substantial and has a p-value of .000052 which is very statistically significant. The Hospital Capacity variable affected white life expectancy positively with an effect of .0257 years and a p-value of .16577, which means the effect is not statistically significant.

Table 1: Number of Hogs and Black Life Expectancy

	Coefficient	Standard Error	P-Value
Intercept	79.39	1.5	<0.05
Number of Hogs per 10k	0.000005	0.000003	0.1
Uninsured rate	-0.05	0.11	0.65
Poverty Rate	-0.22	0.05	<0.05
Hospital Capacity	-0.01	0.02	0.45

Contrary to my hypothesis, hogs have a positive coefficient. The poverty rate is the only statistically significant predictor of Black life expectancy.

Table 2: Number of Hogs and White Life Expectancy

	Coefficient	Standard Error	P-Value
Intercept	80.36	1.73	<0.05
Number of Hogs per 10k	0.000004	0.000004	0.29
Uninsured rate	0.03	0.13	0.79
Poverty Rate	-0.24	0.06	<0.05
Hospital Capacity	0.03	0.02	0.17

Table 2 shows the effects of Hogs and control variables on White Life Expectancy. Hogs, again, have an unexpected positive effect- it is very similar to the effect on Black life expectancy. Here, poverty is again the only statistically significant predictor of life expectancy.

For the next regression, I used the number of hog farms per 10k people within a county instead of the number of pigs to see the effects it has on Black life expectancy. The results I found when running the regression are found in

Table 3. The regression shows that the number of hog farms per 10k has a positive effect on Black life expectancy. Black life expectancy increases by 0.05 years for each additional hog farm per 10,000 people. The impact the number has is pretty small as the ratio of farms to people is typically smaller than the number of hogs. However, the effect is statistically significant as the p-value is .03. The findings definitely do not meet what I hypothesized at all and are quite puzzling. The uninsured rate has negative effects. For every percent increase in the uninsured rate, life expectancy decreases by .09 years, but the effect is not statistically significant. The poverty rate has a negative effect on Black life expectancy with the effect being -.22 years with a p-value of .000017, which means it both has a substantial effect on Black life expectancy and is statistically significant. Finally, the hospital capacity rate has a negative effect of -.00863 which is small and has a p-value of .5876 which means it is not statistically significant.

Table 3: Hog Farms and Black Life Expectancy

	Coefficient	Standard Error	P-Value
Intercept	79.75	1.48	<0.05
Number of Hogs Farms per 10k	0.05	0.03	0.03
Uninsured rate	-0.09	0.11	0.42
Poverty Rate	-0.22	0.05	<0.05
Hospital Capacity	-0.01	0.02	0.59

This table shows the effects of hog farms and control variables on Black Life Expectancy. The Number of hog farms is positively associated with black life expectancy, which is contrary to my expectations. Poverty maintains its negative and statistically significant effect.

The last regression ran estimates the effects that hog farms per 10k have on white life expectancy. The results that were collected through running the regression can be found in Table 4. I hypothesized that the number of hog farms would negatively affect white life expectancy as I had guessed with black life expectancy. The regression found that it had the opposite effect, for each additional hog farm per 10,000 people white life expectancy increases by .02 years. The effect is pretty small especially compared to the effects found with Black life expectancy and it is not statistically significant, as it was for the Black population. The uninsured rate has a positive effect on the white life expectancy rate with an effect of .0468, the p-value was .73 which means the effect is not statistically significant. The poverty rate again shows that it has a negative effect on white life expectancy. The coefficient is -.2381 which is pretty substantial and like before is statistically significant with a p-value of .00006. The hospital capacity shows a positive effect on white life expectancy at .0256 but is not statistically significant with a P-value of .1742.

Table 4: Hog Farms and White Life Expectancy

	Coefficient	Standard Error	P-Value
Intercept	80.13	1.74	<0.05
Number of Hogs Farms per 10k	0.02	0.03	0.43
Uninsured rate	0.05	0.13	0.73
Poverty Rate	-0.24	0.06	<0.05

Hospital Capacity	0.03	0.02	0.17
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The Table shows the effects of hog farms and controlled variables on White Life Expectancy. Again, hog farms have a positive effect, though it is a smaller effect and not statistically significant for the white population.

Conclusion

I argued that hog farms would have a negative effect on community health, especially on the health of the Black community that lives near them. Contrary to expectations, my results ended up showing that there is a positive effect of hogs and hog farms on the life expectancy of both the Black and white populations. The results are puzzling, but when put into application they are not very remarkable. Almost all of my results came out as not statistically significant except for the poverty control variable in every regression and the effect of hog farms on Black life expectancy in one model. The effects of hog farms on Black populations, while being statistically significant, does not have a large effect on life expectancy. The effects are equivalent to less than a month of life added to the life expectancy.

The results of the regressions are not as anticipated, but it could be a function of the data used. There were several limitations on the analysis such as the smallest set of data found is county. County level data does not mean that someone lives in close proximity to a hog CAFO and can cause issues with results. Also the life expectancy data chosen may not have been the best fit for studying the health effects of communities compared to mortality rates or the prevalence of certain diseases and illnesses. Various research before my own shows that negative effects have been found from using mortality rates or asthma rates. Unfortunately, such data was hard to find broken down by race and county. A further limitation of my analysis was the fact that there was not enough data for Black life expectancy for 11 counties and there was no data found for hog numbers or hog farm numbers for 20 counties bringing the county count down to 69 from 100, some of which are located within eastern North Carolina. This means that I was not able to show the true large effects that hog CAFOs may actually have on all counties within North Carolina.

While my data shows that there are not very strong effects of Hog CAFOs on the health of Black Communities within close proximity, previous analyses have. I believe that further research should be done to understand the effects of hogs on life expectancy, as most of the results found in the dataset are not statistically significant. If I could suggest someone to expand on my paper I would point them to use mortality rate and try to find data based on mile radius rather than counties in general. This would help a lot as CAFOs could be concentrated in a certain area of a county, therefore not every person within a county is getting exposed and many communities in neighboring counties could be closer to hog CAFOs than communities further within the county. It could also help to have interviews with people living in close proximity to hog CAFOs to get more personal accounts.

Work Cited

1. Center for Disease Control and Prevention. 2015. "Nitrate and Drinking Water from Private Wells"
2. Environmental Protection Agency. 2018. "CERCLA and EPCRA Reporting Requirements for Air Releases of Hazardous Substances from Animal Waste at Farms"
3. Environmental Working Group. 2016. "Exposing Fields of Filth in North Carolina"
4. Hribar, Carrie and Mark Schultz. 2010. "Understanding Concentrated Animal Feeding Operations and Their Impact on Communities" *The National Association of Local Boards of Health*.

5. Jones, Richard, Erica Hauck, Jim Hatfield, Kevin Good, and Julie Narimatsu. 2017. "Eleven Years After Agreement, EPA Has Not Developed Reliable Emission Estimation Methods to Determine Whether Animal Feeding Operations Comply With Clean Air Act and Other Statutes." *Environmental Protection Agency* 17: 1-30.
6. Kravchenko, Julia, Sung Han Rhew, Igor Akushevich, Pankaj Agarwal, and H. Kim Lysterly. 2018. "Mortality and Health Outcomes in North Carolina Communities Located in Close Proximity to Hog Concentrated Animal Feeding Operations." *North Carolina Medical Journal* 79(5): 278-288.
7. Mirabelli, Maria C., Steve Wing, Stephen W. Marshall, and Timothy C. Wilcosky. 2006. "Asthma Symptoms Among Adolescents Who Attend Public Schools That Are Located Near Confined Swine Feeding Operations" *Pediatrics* 118(1): 66-75
8. Naidenko, Olga. 2018. "Duke University Study: N.C. Residents Living Near Large Hog Farms Have Elevated Disease, Death Risks" *Environmental Working Group*.
9. Nicole, Wendee. 2013. "CAFOs and Environmental Justice: The Case of North Carolina" *Environmental Health Perspective* 121(6):182-189.
10. North Carolina Department of Health and Human Services. 2020. "Hospitals by county: Hospitals Licensed by the State of North Carolina" *Department of Health and Human Services- Division of Health Service Regulation*
11. North Carolina Department of Health and Human Services. 2017-2019. "Life expectancy Reports state and county" *North Carolina Center for Health Statistics*
12. Son, Ji-Young, Rebecca Muenich, Danica Schaffer- Smith, Marie Lynn Miranda, and Michelle Bell. 2021. "Distribution of Environmental Justice Metrics for Exposure to CAFOs in North Carolina, USA." *Environmental Research* 195
13. Wilson, Sacoby M., and Marc L. Serre. 2007. "Examination of atmospheric ammonia levels near hog CAFOs, homes, and schools in Eastern North Carolina" *Atmospheric Environment* 43(23): 4977-4987
14. Wing, Steve, D Cole, and G Grant. 2000. "Environmental Injustice in North Carolina's Hog Industry." *Environmental Health Perspectives* 108(3): 225-31.
15. Wing, Steve, and Jill Johnston. 2014. "Industrial Hog Operations in North Carolina Disproportionately Impact African-Americans, Hispanics and American Indians" *NC Policy Watch*: 1-16.
16. Wing, Steve, and Susanne Wolf. 2000. "Intensive Livestock Operations, Health, and Quality of Life among Eastern North Carolina Residents" *Environmental Health Perspectives* 108(3): 233-238.
17. United States Census Bureau. 2019. "North Carolina quick facts" *U.S Census Bureau*
18. United States Department of Agriculture. 2017. "Hogs and Pigs - Inventory and Sales: 2017 and 2012" *U.S Census of Agriculture* 1(2): 479- 495
19. Yeoman, Barry. 2019. "Here are the rural residents who sued the world's largest hog producer over waste and odors – and won." *Food and Environmental Reporting Network*.

